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L8 and communicat\$6	2

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### Search History

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	<i>DB=USPT; PLUR=YES; OP=ADJ</i>		
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<u>L8</u>	L6 and (present\$6 or software)	2	<u>L8</u>
<u>L7</u>	L6 and uniform\$2 adj present\$6	0	<u>L7</u>
<u>L6</u>	L4 and integrat\$3 same (information or data)	2	<u>L6</u>
<u>L5</u>	L4 and integrat\$3 same (information or data) same uniform\$2 adj present\$6	0	<u>L5</u>
<u>L4</u>	L2 and(identify\$6 or nam\$3) same function\$6	2	<u>L4</u>
<u>L3</u>	L2 and (identify\$6 or id or nam\$3) same cor\$3 adj function\$	0	<u>L3</u>
<u>L2</u>	L1 and business same (strateg\$3 or process\$4 or workflow adj manag\$6)	6	<u>L2</u>
<u>L1</u>	(6052684 or 6041306 or 5999911 or 5960420 or 5960404 or 5870545 or 5867824 5826239 or 5301320).pn.	7	<u>L1</u>

END OF SEARCH HISTORY

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L8: Entry 2 of 2

File: USPT

Sep 28, 1999

DOCUMENT-IDENTIFIER: US 5960420 A

TITLE: Systems, methods and computer program products for implementing a workflow engine in database management system

Brief Summary Text (4):

A new area of technology with increasing importance is the domain of Workflow-Management-Systems (WFMS). WFMS support the modeling and execution of business processes. Business processes control which piece of work of a network of pieces of work will be performed by whom and which resources are exploited for this work. Thus, a business process describes how an enterprise will achieve its business goals. The individual pieces of work might be distributed across a multitude of different computer systems connected by a network.

Brief Summary Text (6):

The correct and efficient execution of business processes within a company, such as development or production processes, may be of enormous importance for a company and may be a significant influence on company's overall success in the marketplace. Therefore, those processes are being regarded similar to technology processes and are being tested, optimized and monitored. The management of such processes is usually performed and supported by a computer based process or workflow management system.

Brief Summary Text (10):

In F. Leymann and D. Roller: "Business Process Management with FlowMark", Digest of papers, Cat. No. 94CH3414-0, Spring COMPCON 94, 1994, pages 230-234, the state-of-the-art computer process management tool IBM FlowMark is described. The meta model of IBM FlowMark is presented as well as the implementation of IBM FlowMark. The possibilities of IBM FlowMark for modelling of business processes as well as their execution are discussed. The product IBM FlowMark is available for different computer platforms, and documentation for IBM FlowMark is available from IBM.

Brief Summary Text (11):

In F. Leymann: "A Meta Model to Support the Modelling and Execution of Processes", Proceedings of the 11th European Meeting on Cybernetics and System Research EMCR92, Vienna, Austria, Apr. 21 to 24, 1992, World Scientific 1992, pages 287 to 294, a meta model for controlling business processes is presented and discussed in detail.

Brief Summary Text (12):

The "IBM FlowMark for OS/2", document number GH 19-8215-01, IBM Corporation, 1994, available from IBM, represents a modern, sophisticated, and powerful workflow management system. It supports the modelling of business processes as a network of activities. This network of activities, referred to as the process model, is constructed as a directed, acyclic, weighted, colored graph. The nodes of the graph represent the activities or work items which are performed. The edges of the graph, referred to as the control connectors, describe the potential sequence of execution of the activities. Definition of the process graph is via the IBM FlowMark Definition Language (FDL) or the built-in graphical editor. The runtime component

of the workflow manager interprets the process graph and distributes the execution of activities to the right person at the right place, e. g. by assigning tasks to a work list according to the respective person, wherein the work list is stored as digital data within the workflow or process management computer system.

Brief Summary Text (13):

In F. Leymann and W. Altenhuber: "Managing Business Processes as an Information Resource", IBM Systems Journal, Vol. 32(2), 1994, the mathematical theory underlying the IBM FlowMark product is described.

Brief Summary Text (14):

In D. Roller: "Verifikation von Workflows in IBM FlowMark", in J. Becker und G. Vossen (Hrsg.): "Geschaeftsprozessmodellierung und Workflows", International Thompson Publishing, 1995, the requirement and possibility of the verification of workflows is described. Furthermore the feature of graphical animation for verification of the process logic is presented as it is implemented within the IBM FlowMark product.

Brief Summary Text (15):

To implement a computer based process management system, the business processes are analyzed and, as the result of this analysis, a process model is constructed as a network of activities corresponding to the business process. In the IBM FlowMark product, the process models are not transformed into an executable. At run time, an instance of the process is created from the process model, called a process instance. This process instance is then interpreted dynamically by the IBM FlowMark product.

Brief Summary Text (17):

It is generally desirable to improve a WFMS's throughput and responsiveness. Throughput and responsiveness may be impaired by the distributed nature of executing process models by WFMS, the huge amount of WFMS state information for very complex process models and the potentially large number of simultaneous users of a WFMS. Thus, there is a continuing need to improve internal processing speed and throughput of the WFMS to deliver as much as possible of the computer systems' processing power to the business processes themselves.

Detailed Description Text (6):

From an enterprise point of view the management of business processes is becoming increasingly important. Business processes control which piece of work will be performed by whom and which resources are exploited for this work. In other words, a business process describes how an enterprise will achieve its business goals. A WFMS may support both the modeling of business processes and their execution.

Detailed Description Text (7):

Modeling of a business process as a syntactical unit in a way that is directly supported by a software system is extremely desirable. Moreover, the software system can also work as an interpreter basically obtaining as input such a model. The model, called a process model, can then be instantiated and the individual sequence of work steps depending on the context of the instantiation of the model can be determined. Such a model of a business process can be perceived as a template for a class of similar processes performed within an enterprise. It is a schema describing all possible execution variants of a particular kind of business process. An instance of such a model and its interpretation represents an individual process, i.e. a concrete, context dependent execution of a variant prescribed by the model. A WFMS facilitates the management of business processes. It allows modeling of business processes (build time) and it drives business processes based on an associated model (run time). The meta model of IBM's WFMS FlowMark, i.e. the syntactical elements provided for describing business process models, and the meaning and interpretation of these syntactical elements, is described next.

Detailed Description Text (8):

Activities are the fundamental elements of the meta model. An activity represents a business action that is from a certain perspective a semantical entity of its own. The model of the business process might have a fine-structure that is then represented in turn via a model, or the details of it may not be of interest from a business process modeling point of view. Refinement of activities via process models allows for both modeling business processes bottom-up and top-down.

Detailed Description Text (10):

Since activities might not be executed arbitrarily they are bound together via control connectors. A control connector might be perceived as a directed edge between two activities. The activity at the connector's end point cannot start before the activity at the start point of the connector has finished (successfully). Control connectors thus model the potential flow of control within a business process model.

Detailed Description Text (11):

In addition, a Boolean expression called a transition condition is associated with each control connector. Parameters from output containers of activities having already produced their results are followed as parameters referenced in transition conditions. When at run time an activity terminates successfully, all control connectors leaving this activity are determined and the truth value of the associated transition conditions is computed based on the actual values of their parameters. Only the end points of control connectors the transition conditions of which evaluated to TRUE are considered as activities that might be executed based on the actual context of the business process. Transition conditions thus model the context dependent actual flow of control within a business process (i.e. an instance of a model).

Detailed Description Text (12):

FlowMark includes, at the highest level, a build time component and a run time component. The build time component supports the modeling of business processes according to the meta model described above, and the run time component supports the corresponding semantics. Both components are implemented in a client-server structure. The client delivers the interaction with the user via an object-oriented graphical interface, invokes local tools, and provides animation. The server maintains the database for process instances, navigates through the process graph, and assigns the activities to the proper resources.

Detailed Description Text (51):

Based on the stored procedure technology a WFMS control function, such as the Start a Process Instance code fragment example for starting a process, may be implemented as two pieces. One piece is the client piece 801, for which a fragment is shown in FIG. 9. Statement 1 declares two host variables, procName to hold the name of the stored procedure which starts a process instance, and processModelId to hold the identifier (name) of the process model for which a process should be started. Statement 2 then calls the stored procedure startPrc and passes the name of the process model in parenthesis. Thus, this client piece of the WFMS control function may be a small stub representing the WFMS control function within the WFMS and which requests the associated service of the stored procedure within the DBMS to perform the service request and to deliver the actual processing results to a caller.

Detailed Description Text (55):

Implementing the WFMS control functions as stored procedures changes the structure of the WFMS implementation to architectures depicted in FIG. 11. A WFMS navigation step, such as starting a process or finishing a workitem, may be implemented as a stored procedure which is called by the WFMS. More precisely a WFMS control function stub 1101 may request the service of an associated WFMS control function

core 1102, now located within the RDMS 1103. Since all work may be done in the database, reduced interaction and data passing between the WFMS and the RDBMS may be employed. All SQL calls can be performed within the stored procedure. No containers, for example, need be retrieved from the database into the WFMS workspace and stored back later into the database. By comparing the WFMS structure of FIG. 10 to that of FIG. 11 it can be seen that the current invention can achieve a large amount of integration of two separate areas of technology, WFMS and DBMS technology.

Other Reference Publication (3):

IBM Software Solutions, IBM FlowMark for OS/2, Document No. GH 19-8215-01, 1994.

Other Reference Publication (4):

Leymann et al, "Managing Business Processes as an Information Resource", IBM Systems Journal, vol. 33, No. 2, 1994, pp. 326-348.

Other Reference Publication (5):

Leyman et al., "Business Process Management with FlowMark", IEEE, Spring COMPCON 94, 1994, pp. 230-234.

## Hit List

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Search Results - Record(s) 1 through 2 of 2 returned.

☐ 1. Document ID: US 6041306 A

L10: Entry 1 of 2

File: USPT

Mar 21, 2000

US-PAT-NO: 6041306

DOCUMENT-IDENTIFIER: US 6041306 A

TITLE: System and method for performing flexible workflow process execution in a distributed workflow management system

Full	Title	Citation	Front	Review	Classification	Date	Reference	Abstract	Claims	KWIC	Drawings
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☐ 2. Document ID: US 5960420 A

L10: Entry 2 of 2

File: USPT

Sep 28, 1999

US-PAT-NO: 5960420

DOCUMENT-IDENTIFIER: US 5960420 A

TITLE: Systems, methods and computer program products for implementing a workflow engine in database management system

Full	Title	Citation	Front	Review	Classification	Date	Reference	Abstract	Claims	KWIC	Drawings
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US005960420A

**United States Patent** [19]

Leymann et al.

[11] **Patent Number:** **5,960,420**[45] **Date of Patent:** **Sep. 28, 1999**

[54] **SYSTEMS, METHODS AND COMPUTER PROGRAM PRODUCTS FOR IMPLEMENTING A WORKFLOW ENGINE IN DATABASE MANAGEMENT SYSTEM**

[75] Inventors: **Frank Leymann, Aidlingen; Dieter Roller, Schönaich**, both of Germany

[73] Assignee: **International Business Machines Corporation, Armonk, N.Y.**

[21] Appl. No.: **08/923,748**

[22] Filed: **Sep. 2, 1997**

[30] **Foreign Application Priority Data**

Sep. 11, 1996 [EP] European Pat. Off. .... 96114506

[51] Int. Cl.<sup>6</sup> ..... **G06F 17/30**

[52] U.S. Cl. .... **707/1; 707/10; 707/100; 707/104**

[58] Field of Search .... **707/1, 103, 10, 707/100, 104; 705/8**

[56] **References Cited****U.S. PATENT DOCUMENTS**

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5,799,297	8/1998	Goodridge et al.	707/1
5,826,239	10/1998	Du et al.	705/8
5,848,393	12/1998	Goodridge et al.	705/8

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Alonso, "The role of database technology in workflow management systems", Proceedings IFCIS, Jun. 21, 1996.

IBM Software Solutions, IBM FlowMark for OS/2, Document No. GH 19-8215-01, 1994.

Leymann et al, "Managing Business Processes as an Information Resource", IBM Systems Journal, vol. 33, No. 2, 1994, pp. 326-348.

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Leymann, "A Metal Model to Support Modelling and Execution of Process", Proceedings of the 11<sup>th</sup> European Meeting on Cybernetics and System Research EMC92, Vienna, Austria, Apr. 22 to 14, 1992, pp. 287-294.

D.J. Spoon: Project Management Environment@, IBM Technical Disclosure Bulletin, vol. 32, No. 9A, Feb. 1990, pp. 250-254.

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*Primary Examiner*—Paul R. Lintz

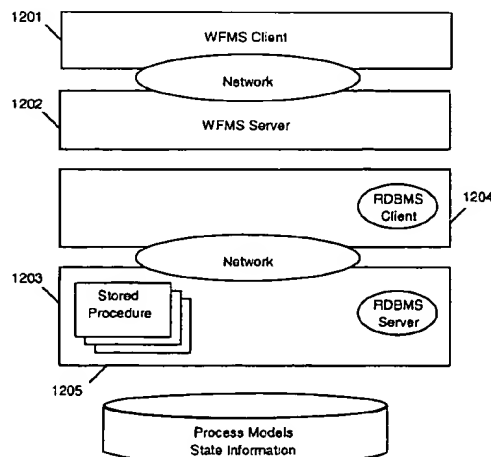
*Assistant Examiner*—Sanjiv Shah

*Attorney, Agent, or Firm*—Myers Bigel Sibley & Sajovec; A. Bruce Clay

[57]

**ABSTRACT**

Workflow management systems (WFMS) execute a multitude of process models including a network of potentially distributed activities. WFMS store WFMS state information on the process models, the process model instances currently executed by the WFMS, together with the instances's state and the state of the WFMS themselves, in Database Management Systems (DBMS). The WFMS engines encompassing a set of control functions are implemented directly within the DBMS. Only stubs corresponding to these control functions need be implemented within the WFMS. The stubs exploit the services of the control function cores within the DBMS. Such implementation architectures can increase performance of WFMS significantly as the control functions can operate on and within those computer systems which store the data on the WFMS state.

**24 Claims, 8 Drawing Sheets**





US006041306A

**United States Patent** [19]

Du et al.

[11] Patent Number: **6,041,306**[45] Date of Patent: **Mar. 21, 2000**

[54] **SYSTEM AND METHOD FOR PERFORMING FLEXIBLE WORKFLOW PROCESS EXECUTION IN A DISTRIBUTED WORKFLOW MANAGEMENT SYSTEM**

[75] Inventors: **Welmín Du**, San Jose; **James W. Davis**; **Clemens Pfeifer**, both of Sunnyvale; **Ming-Chien Shan**, Saratoga; **Nicolas Sheard**, Palo Alto, all of Calif.

[73] Assignee: **Hewlett-Packard Company**, Palo Alto, Calif.

[21] Appl. No.: **08/821,940**

[22] Filed: **Mar. 21, 1997**

**Related U.S. Application Data**

[60] Provisional application No. 60/032,567, Dec. 5, 1996.

[51] Int. Cl.<sup>7</sup> ..... **G06F 9/40**

[52] U.S. Cl. .... **705/8; 705/7; 705/8**

[58] Field of Search ..... **705/8, 7, 9; 395/200.31, 395/200.32, 200.33, 182.13**

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Hollingsworth, "Workflow Management Coalition", pp. 1-55, Jan. 19, 1995.

*Primary Examiner*—**Tod R. Swann**

*Assistant Examiner*—**Matthew Smithers**

*Attorney, Agent, or Firm*—**Thomas X. Li**

[57]

**ABSTRACT**

A system and method for performing flexible workflow process execution in a distributed workflow management system is described. The distributed workflow management system is formed by a computer network comprising a plurality of computers. Each computer has a processor, memory and input/output facilities. A workflow process management system operates on one or more of the computers to control the computer network in executing the workflow process. The workflow process includes at least one sequence of multiple actions. A plurality of resources is coupled to respective ones of the computers to carry out the multiple actions. A plurality of state machines are stored as computer-operable code in at least one memory and include a plurality of states interconnected by arcs logically forming a directed graph. The workflow management system further includes logic for instantiating each action with one state and logic for executing the logical sequence of the action as state transitions in each state machine.

**7 Claims, 10 Drawing Sheets**